Design Procedures

Document Number EN-DMPS-201
Revision 8
Approved by [redacted]
DHQ, Stations
05/23/05

Active Divisions/Departments
FEMC
Environmental, Health, and Safety

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Purpose

To define the process used for the design of projects.

Scope/Applicability

This procedure applies to all engineering designs for construction and maintenance projects accomplished by Raytheon Polar Services Company (RPSC), and may include participation from the following: all RPSC Divisions, the NSF, Raytheon Corporate, USAP Agencies, User Committees, 3Rd party Auditors, Grantees, Suppliers, and A&E Firms).

Terms and Definitions

AutoCAD

Automated Computer Aided Design.

Design Codes

Nationally or internationally recognized codes/regulations addressing fundamental principals regarding practical safeguarding of personnel and protection of public health and welfare by regulating and controlling design, construction, quality of materials and installation practices.

Design Phase

Designated phases of design completion based on prescribed review cycles. (i.e. 30%, 60%, 90%, 100%, Approved for Construction - AFC) Review cycles may vary based on the complexity of the project.

Discipline

A division of engineering identified by title. (i.e. Civil, Architectural, Structural, Mechanical, Electrical, Communications, Fire, etc.)

Engineering Project Definitions (EPD)

A document developed prior to the start of any engineering study, design, and/or construction/maintenance work requiring new facilities or modification to existing facilities. The EPD becomes the basis of scope and requirements for the engineering study, design, and/or construction/maintenance work.

Interim Drawing

A drawing utilized to depict minor design changes initiated through the RFI / CR process. Interim drawings facilitate uninterrupted workflow of projects between major design changes/revisions.

Responsibilities

Director, FEMC

- Ensures this procedure is followed for all engineering and construction projects.
- Interfaces with the National Science Foundation on all design approvals.

Manager, Engineering

- Assigns work to the appropriate Project Engineer and Support team.
- Supervises the accomplishment of all designs.
- Assures that designs are accomplished properly, utilizing appropriate codes, standards, procedures, and specifications.
- Informs the Director, FEMC, on the status of design work and maintains a schedule of designs in progress showing critical milestones and completion dates.
- Approves all design products prior to release.

- Assures that Quality Assurance will be accomplished following *Design Quality Assurance Plan* (EN-DMPS-205).

Manager, FEMC

- Assists in the review of all designs.
- Provides input and requirements for design feasibility.

Project Lead/Engineers and Design Engineers

- Accomplish the engineering design.
- Utilize the proper codes, standards, procedures, and specifications for the accomplishment of the design.
- Coordinate with user personnel to define requirements.
- Establishes and writes specifications, data sheets, equipment lists, and any other design documents to support the design effort.
- Records and maintains calculations.
- Checks the work of others.

Document Control Specialist

- Maintains the master project/drawing files for the repository of design documents.
- Coordinates reproduction and distribution of design documents.

Environmental Health and Safety

EH&S will review drawings for asbestos issues, safety requirements, and environmental concerns.

General

- This procedure will be used to produce all designs, regardless of the size or discipline of the engineering design.
- This procedure sets the format that will be used for all designs so they will be produced in a uniform manner.

Procedures

Engineering Project Definitions

All design projects begin with preparation of the Engineering Project Definition (EPD) following the guidelines in the procedure *Engineering Project Definitions* (EN-D-200). The EPD provides the basis for the design.

Design Phases

In general, projects will be reviewed on 90% and 100% basis of design completion; however, some projects vary and may require additional reviews (See *Design Review Form* (EN-DMPS-216d) for design review approval form).

30%/60% Design (if required)(Revision or "Preliminary (P)" level release)

If required, the 30% and/or 60% design will check the validity of the criteria set forth in the EPD and further expound on the overall design requirements. The preliminary design would typically include the following:

- Sketches or drawings of the basic design
- Preliminary design description
- List of building/safety codes applicable to the project
- Preliminary environmental and safety requirements.

90% and 100% Designs

The 90%/100% design incorporates any comments received from previous design reviews. Each subsequent design incorporates the changes noted during the previous design review. (Alpha level Releases Rev. A, B, C, etc.)

Design Reviews

Design reviews shall consist of a technical examination by RPSC divisions, construction, users, client, and/or third parties to ensure compliance and

applicability of engineering designs (See the *Design Review Form* (EN-DMPS-216d)).

Design Calculations

- Each page of the calculations will include the project title, design engineer's name, date, page number, and WBS or job number.
- The calculations will be accomplished in a clear and logical manner so that anyone can follow the logic of the design. When manuals, codes, or tables are used to obtain a result or as part of the design process, they will be referenced. Appropriate copies of the applicable pages or table will be included as part of the design calculations. The design calculations will include sketches and diagrams showing critical design dimensions, material sizing, material types and specifications, and other data important to the design.
- Upon completion, an engineer that is knowledgeable in the design discipline and understands the design concepts being utilized will review the calculations and fill out the *Calculations Review Sheet* (EN-DMPS-201b).
- Completed calculations will be submitted to and filed in the project WBS file in Document Control where any further distribution will be by request only.

Design Sketches

- The Project Engineer will produce design sketches.
- All design sketches will include the project title, the design engineer's name, date, page or sheet number, and WBS or job number. ("P" level Releases.)
- Upon completion, an engineer that is knowledgeable in the design discipline and understands the design concepts being utilized will check the sketches.

Design Drawings

- A designer, drafter, or engineer will produce design drawings. These drawings will be accomplished by utilizing FEMC's CADD System.
- Refer to the FEMC's drafting procedures for a detailed description of drafting standards, including procedures for drafting standards, electronic filing and naming conventions, converting to AutoCAD, and plotting.

Interim Drawings

Interim drawings shall be generated in accordance with *Change Request / Request for Information (RFI) (*EN-CDMPS-207).

A CADD designer or engineer will produce interim drawings. These drawings will be accomplished by utilizing FEMCs AutoCAD System.

Design Codes

All designs will conform to the requirements of the International Building Codes (IBC). If the IBC is silent on/or does not address a particular issue, the design will conform to the requirements of the National Fire Protection Association (NFPA). Consequently, designs will conform to the following versions of the codes in use by PACNAVFACENGCOM (PACDIV) (Pacific Division Naval Facilities Engineering Command) at the time that the designs were initiated:

International Building Code (IBC), 2003

International Plumbing Code (IPC), 2003

International Mechanical Code (IMC), 2003

NFPA 70 *National Electrical Code* (NEC), 2003

NFPA 101 *Life Safety Code*, 2003

NFPA 90A *Standard for the Installation of Air-Conditioning and Ventilation Systems*, 2002

NFPA 75 *Standard for Protection of IT Equipment*, 2003

NFPA 72 *National Fire Alarm Code*, 2002

Submittals

The submittal of each design phase will follow these steps:

- Each of the submittals will be mailed to the NSF with a transmittal form and delivered to other RPSC Divisions affected by the design. Distribution of the documents will be the responsibility of the Engineering Document Control Specialist (DCS).
- When the comments are received from the reviewers, they will be recorded and filed by the DCS, and a copy will be given to the assigned Project Engineer.
- The Project Engineer will review the comments. If they are acceptable, the comments will be incorporated into the design. If the comments are unacceptable or clarification is required, the Project Engineer will contact the reviewers to discuss and clarify the points at issue. Any discussions and/or resolutions will be recorded and placed in the project master file, and the design will include the agreed upon revisions and/or additions.
- As the design progresses, changes made due to client/user reviews will be referenced in the revision block on the drawing per the *CADD Manual* (EN-DMPS-101).

Final Approval Process

- The Project Lead and/or Project Engineer will coordinate the in-house final approval of all designs. This will be accomplished after all requirements in procedure *Design Quality Assurance Plan* (EN-DMPS-205) have been accomplished. RPSC approvals **may** include the following groups, as **applicable to the project**:
  - Engineering
  - Facilities Construction and Maintenance
  - Quality Assurance PA/QA
  - Environmental, Health and Safety
  - Operations
  - Science Support

- IT

- The Manager, Engineering will coordinate the design approvals from the NSF.
- Final signature approvals are recorded on the engineering drawing title block prior to AFC release.
- The AFC drawing set is copied to a CD as backup and kept by Document Control, and an electronic copy is sent to the Antarctic Stations.

Distribution/Use

- The designs are intended for use during construction of a project. The final drawings (AFCs) will be distributed and issued for construction only after all final approvals are obtained. Draft copies may be distributed with the approval of the Manager, Engineering, but must be clearly marked as such in red ink block letters at least ¾ inch tall, and shall designate "Preliminary," "For Review," or "Draft Only."
- Following the 100% submittal and addition of all final comments, the "issued for construction" set, rev 0, will be completed. The drawing set(s) will be delivered to the Construction Coordinator in charge of project construction and to Planning and Controls/MTO by the Document Control Specialist.
- A reproducible and signed copy of this set will be delivered to the Engineering Document Control Specialist for permanent filing in the master project drawing file.
- Distribution of approved drawings and controlled design documents shall be facilitated by completing a *Document Release Form (DRF)* (EN-DMPS-201a). The Project Lead or designee shall complete the DRF and submit to the Document Control Specialist for processing. The Document Control Specialist shall distribute the drawings/documents per the DRF.

References

CADD Manual (EN-DMPS-101)

Calculations Review Sheet (EN-DMPS-201b)

Document Release Form (DRF) (EN-DMPS-201a)

Design Quality Assurance Plan (EN-DMPS-205)

Design Review Form (EN-DMPS-216d)

Engineering Project Definitions (EN-D-200)

FEMC Records Management Table (EN-D-226a)

(All FEMC procedures and forms are available on the Master List/FEMC)

Records

See “Drawings, Submittals, and Project Files” under the FEMC-DHQ & STATIONS tab of the *FEMC Records Management Table* (EN-D-226a).